

## **New data on a cultural control method against coconut lethal yellowing in Ghana**

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### **Abstract**

Lethal yellowing disease has been rife in West Africa, especially Ghana, since 1932. In the 1990s, the first operations to fell diseased coconut palms at an early stage showed that this substantially slowed down the spread of the disease.

Trial conducted in 1995 showed that early felling of diseased coconut palms, even without prior treatment, considerably slowed down the spread of the disease. Replications of this action in several other plots kept them healthy for many years. These positive results made it possible to obtain funding from *Agence française de Développement* (AFD) to maintain a "sanitary cordon" in the far West of the Western Region of Ghana, near the Ivorian border, where there is a wide area of coconut palms.

**Keywords:** Coconut, lethal yellowing, early felling and Ghana.

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## Introduction

Coconut (*Cocos nucifera*) is a well-known cash crop in the coastal region of Ghana. It is a good source of income for numerous smallholders in the zone. It also generates jobs in this rural zone. Indeed, annual coconut production is estimated at several hundred thousand tonnes from 43,000 ha of coconut plantings (Ofori and Nkansah Poku, 1997).

A very serious disease, coconut lethal yellowing, caused by a phytoplasma (Tymon *et al.*, 1995) and probably transmitted by a sucking-piercing insect, has been rife for many years in Ghana, firstly in Volta Region, then Western Region and lastly Central Region. In all, throughout these three regions of Ghana, over 10,000 ha of coconut plantings have already been decimated and the disease is currently very active in the Central and Western Regions (Dery *et al.*, 1997).

After 15 to 20 years, trials of coconut hybrid varieties have revealed two coconut varieties with tolerance or resistance to this disease (Mariau *et al.*, 1996; Dery *et al.*, 1997 and 1999). A rehabilitation programmed for Ghanaian coconut plantings is under way with funding from *Agence Francaise de Developpement (AFD)*.

In order to slow down the spread of this disease, which can be rapid in the rainy season, trials involving felling and insecticide treatment against sucking-piercing insects have been carried out in the Central Region of Ghana.

An early felling trial was conducted in 4 plots in the locality of Ayensudu (Central Region) beginning in 1995. Initial data were presented at the first international seminar held at Ceiba Atlantida (Honduras) on 16 and 17 November 2000 (Dery *et al.*, 2000). Observations continued after that date to determine the spread of the disease when felling operations were suddenly halted.

## Materials and methods

In the vicinity of Ayensudu (Central Region), the disease started to develop in four

plots: diseased coconut palms at all stages of development and different levels of infection according to the number of diseased coconut palms at the beginning of the trial were available (Table 1). It was thus possible to carry out the following interventions:

- Plot 21 (248 coconut palms): Felling only each time new disease cases occurred.
- Plot 22 (134 coconut palms): Felling + only 2 hot-fogging treatments were carried out at the beginning.

The first treatment was carried out on 22 June 1995 with Propoxur (Unden liquid 200 g *a.i.* per litre): 0.5 litres of Unden mixed with 6 litres of diesel oil. One mixture was hot-fogged in the plot. After that first treatment, two diseased coconut palms were felled the same day. Six months later, on 22 December 1995 a second treatment was carried out with chlorpyrifos (Durban 480 g *a.i.* per litre): 0.5 litres of Dursban mixed with 6 litres of diesel oil. One mixture was hot-fogged in the plot. No diseased coconut palms were observed at that time.

Felling was continued each time new disease cases appeared.

- Plot 23 (301 coconut palms): Felling + hot-fogging treatment with chlorpyrifos each time new cases occurred.

The first treatment was carried out on 28/12/95 with the same dosage of chlorpyrifos as above. Two mixtures were hot-fogged in the plot. After treatment, 6 diseased coconut palms were felled the same day. The second treatment was carried out roughly one year after the first one, on 15/10/96 with the same insecticide at the same dosage. After treatment, 3 diseased coconut palms were felled the same day. The third treatment was carried out 1.5 years after the second one, on 28/03/98 with the same insecticide at the same dosage. After treatment, 2 diseased coconut palms were felled the same day. Thereafter, felling was continued in the plot each time new cases occurred.

- Plot 24 (360 coconut palms): only one hot-fogging treatment without felling was carried out on

23/07/96 with chlorpyrifos. Three mixtures of Durban with diesel oil, as above, were hot-fogged in the plot. There were already 14 diseased coconut palms, which were not felled (Table 1).

Checks were made every three months and physical or chemical action was taken, where necessary, in the week following the observations.

## Results and discussions

Felling of the first diseased coconuts showing the very first symptoms of infection (nut fall and yellowing of lower fronds), appreciably reduced disease extension within an infected plot. Over a 5-year period (1995-1999), losses on coconut farms varied from 3 to 4% (Table 1). However, the difference with the effect of felling combined with hot-fogging treatments was not significant. Furthermore, very early intervention in a plot with fewer than five diseased coconuts prevented intensive multiplication of the infectious inoculums.

Figure 1 shows that the coconut palms rapidly became infected once all the felling and treatment operations were stopped.

Near the village of Abakrampa, a coconut planting of around 14 ha was infected in December 1992 (near the Secondary School = 1 coconut palm infected; near the village = 2 coconut palms infected). Felling was carried out in May 1993. In July 1995, 7 new diseased coconut palms were detected near the village and were felled in September 95. In July 1996, another 7 cases were identified near the village and were felled a month later. Felling was then halted because of lack of funds; the disease gradually eliminated the palm grove within 5 years.

It has been further demonstrated in several villages: Azuleti, Moree, that when felling is carried out right at the beginning of a disease focus (1 to 3 coconuts affected) the spread is drastically slowed down. For example, at Azuleti, felling was carried out in 1995. To date, the

disease has not reappeared. In some instances, further felling is required. Where this is not done or action is delayed, the disease spreads very rapidly (e.g. Asebu).

These results indicate that felling reduces the inoculums to such a low level that the occurrence of new disease cases is distinctly slowed down. To date, disease transmission has not been formally elucidated, despite 4 years of experiments under an EC-funded STD3 project (Dery *et al.*, 1995a, 1996). Should transmission be by insects, these positive early felling results would suggest that the emergence of the disease in a healthy spot is only due to a few infectious sucking-piercing insects. So far, no outbreak of a particular species of this group of insects has ever been observed on diseased coconut palms isolated at the start of infection in a given plot. The first diseased coconut palms are several dozen metres apart and up to a few hundred metres apart in the same infected plot. At the start of the disease in a plot, it is rare to see two neighbouring infected palms. However, if the first diseased palms are left in place, neighbouring palms can be contaminated in turn by any sucking-piercing insects capable of transporting the pathogen. The time taken for transmission from the first infected coconut palms to their neighbours would therefore seem to depend on the speed with which the phytoplasma multiplies in the plant, and the number of sucking-piercing insects in the immediate vicinity of the first coconut palms infected.

If there are more than 10 coconut palms showing symptoms of the disease, felling will no longer give the same beneficial effect. It would seem that by this level of infection, there is sufficient inoculum for the disease to be spread rapidly by sucking-piercing insects. Palms subsequently infected are the immediate neighbours of the first infected palms, and the disease spreads in "patches" (Dery and Philippe, 1995b). Consequently, it would be useful to start felling as soon as diseased coconut palms appear, so as to prevent the inoculum from accumulating in a given plot.

**Table 1. Effect of a felling and/or chemical treatment on the spread of coconut lethal yellowing**

Treatments	Total number of coconut palms affected by lethal yellowing									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Plot 21 (248 coconut palms) Felling only	1 (0.4%)	2 (0.8%)	2 (0.8%)	4 (1.6%)	8 (3%)	27 (11%)	62 (25%)	190 (76.6%)	228 (91,9%)	248 (100%)
Plot 22 (134 coconut palms) Felling + 2 treatments only in 1995	2 (1.5%)	2 (1.5%)	2 (1.5%)	2 (1.5%)	4 (3%)	19 (14%)	48 (35.8%)	98 (73.1%)	123 (91,8%)	131 (97,8%)
Plot 23 (301 coconut palms) Felling + Treatment as new cases occurred (3 treatments)	6 (2%)	9 (3%)	9 (3%)	11 (3.65%)	11 (3.65%)	18 (6%)	40 (13.3%)	224 (74,4%)	282 (93,7%)	297 (98,7%)
Plot 24 (360 coconut palms) One treatment only without cutting all along the trial		14 (4%)	70 (19%)	160 (44%)	285 (79%)	296 (82%)	298 (82,7%)	299 (83%)	359 (99,7%)	359 (99,7%)

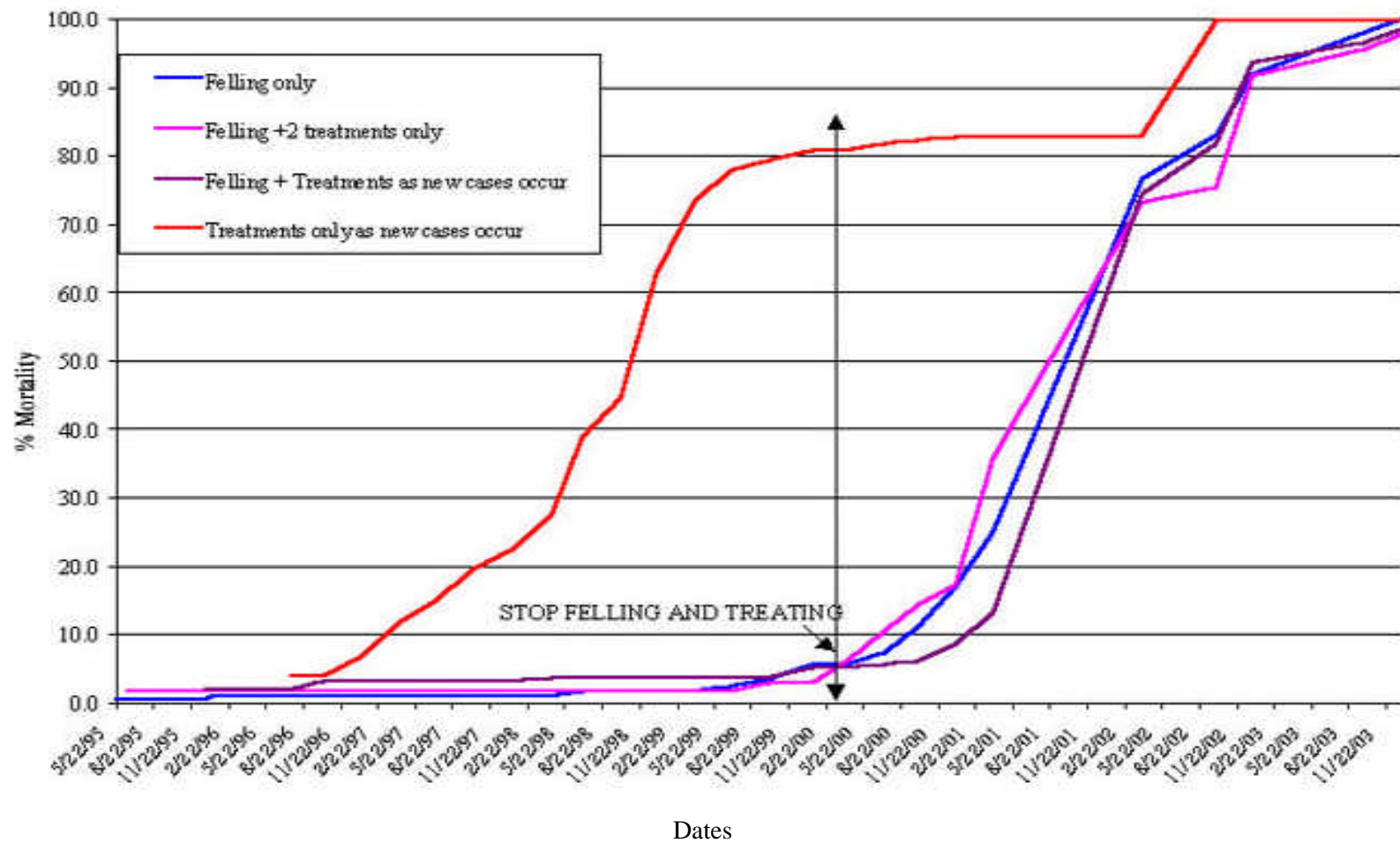


Fig. 1. Effect of felling (with or without treatment) on the spread of coconut lethal yellowing

Under a project funded by AFD, early felling or containment operations are being carried out from April 2003 by a specialized team (3 people) equipped with a pick-up truck and a chainsaw. The main purpose of this dedicated team is to prevent any disease propagation in the extreme West of Ghana, which is covered by a large area of coconut palms (around 18,000 ha in one swathe belonging to around 15,000 growers). In that part of Western Region, coconut is the main cash crop. Thus, any new disease foci at Nkroful (Western Region) for example have been eradicated as and when they appear. The same applies for old foci at Ampain (Western Region). These two foci were regularly monitored and sanitized. A total of 434 diseased palms were eliminated at these foci: 175 at Ampain and 259 at Nkroful (Table 2). Another disease front in the Shama Ahanta East District was also contained: 94 diseased palms were felled at this focus. Two extensive surveys were carried in the Nzema East and Jomoro districts to identify any incipient disease focus. None was found beyond the Ampain focus. Beyond the main Nkroful focus, ten incipient foci were identified in the second survey conducted in October 2003. These were located at Teleku-Bobazo and the surrounding area. All the diseased palms in the foci were eliminated (Table 2). One other focus was also identified at Nkroful, near to the main focus.

**Table 2. Elimination of infected palms at identified lethal yellowing disease foci**

Location	No. of foci	No. of infected palms
Ampain	1	175
Nkroful	2	259
Teleku-Bokazo	10	169
Dabose Junction	1	94
Total	14	697

This method has apparently been applied in Mozambique (AFD project) in the Madal coconut estate with success. It has yet to be applied to

smallholdings (de Franqueville, 2004, personal communication).

Felling infected coconut palms is a method that has also been applied to a coconut root disease (Coconut root (wilt) disease) in Kerala (India), which is apparently caused by a phytoplasma (Solomon *et al.*, 1983). This disease does not kill the palms, but it causes a considerable drop in yields (Rethinam *et al.*, 1982). In this case, felling is followed by phytosanitary measures, unlike with lethal yellowing where diseased palms are felled early and left as they are in the plots. After felling, palms with infected roots are burnt on site. Carbaryl treatments are carried out to eliminate the vector *Stephanitis typica* (Muralidharan *et al.*, 1990). All in all, a code of conduct has been adopted by the official authorities in Kerala: identification of all diseased coconut palms, spraying with 0.05% carbaryl, felling and removal of infected palms with their bole and roots, and burning of the bole and roots on site.

## Conclusion

It may be possible for growers to proceed solely with early felling of diseased coconut palms revealed by meticulous monitoring of their coconut plantings. Under no circumstances felling should be delayed once there are more than 5 diseased coconut palms, otherwise felling would seem no longer to slow down the spread of the disease. In that way, early felling of palms showing symptoms of the disease should allow growers to avoid the additional work required for chemical treatments.

## Acknowledgement

We wish to thank Mr Kenneth Atta-Peters, for assisting in the collection of field data. This study was funded by EC STD3 project from 1995 to 1997 and then by World Bank under the National Agriculture Research Project.

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